Memorandum

Date:	Tuesday, February 14, 2023
Project:	Forward 2044
To:	Cedar Rapids Linn County Solid Waste Agency (CRLCSWA) Karmin McShane, Executive Director
From:	HDR Engineering, Inc. (HDR) Lori Calub, Kate Bartelt, Morgan Mays
Subject:	**Forward 2044 Executive Summary of TM 2022 Food Waste Digester Feasibility Study**

Introduction

This Memorandum summarizes findings from the 2022 *Food Waste Digester Feasibility Technical Memorandum* (TM), prepared for the City of Cedar Rapids by HDR. It provides recommendations for the next steps for the Cedar Rapids Linn County Solid Waste Agency (CRLCSWA or the Agency). The TM discussed the feasibility and benefit of diverting food wastes generated within the CRLCSWA service area to a dedicated anaerobic digestion (AD) digester owned and operated by the Cedar Rapids Water Pollution Control Facility (WPCF).

Overview of Anaerobic Digestion and How it Works

AD is a biological process that breaks down food waste with the help of microbes in an oxygen-free environment to create biogas and digestate. When food waste arrives at the anaerobic digestion facility, the material is placed into a digester, which is a large, airtight tank (or container) where the materials break down.

Inside the digester, special microbes break down (or digest) the food waste. This process creates a biogas, which is a renewable energy source that's a mixture of gases and one of the products of anaerobic digestion. It's mostly comprised of methane but also includes a small amount of other gases. The biogas can be processed into renewable natural gas (RNG), which can be used in place of fossil natural gas and for vehicle fuel, energy products, or bioproducts such as bioplastics. Potential revenues and tipping fees generated by the AD facility will depend on the quantity and quality of RNG produced. The TM used RNG revenues ranging from $10 per Metric Million British Thermal Unit (MMBtu) to $20/MMBtu to reflect the volatility in the RNG market.

A product called digestate, a wet mixture of solids and liquids rich in nutrients that can be used to create fertilizer, compost, and other agriculture and gardening products, is also produced. The biogas is captured, and the digestate is turned into valuable material for use.

Study Objectives

The purpose of the evaluation was to investigate if AD at the WPCF would be a viable and mutually beneficial waste solution for food waste in the near term or post-closure of the existing landfill (beyond 2044). Please note that the study did not explore other types of AD systems, such as high solids, plug flow, or dry digestion, but rather remained focused only on wastewater-type digestion at the WPCF as an expansion of the already planned improvements.

Analysis
CRLCSWA does not currently have a food scrap diversion program, so the evaluation looked at two different AD solutions. For each Alternative, a separate digester was evaluated to manage food waste only. Two sizes of digesters were evaluated. Alternative 1 looked at building a full-sized AD digester similar to those planned during the Phase 1 improvements at the WPCF. While Alternative 2 looked at an optimized-sized digestor that meets the expected food waste volume diverted from CRLCSWA, assuming a voluntary food waste program is initiated.

> *Alternative 1* evaluated an individual digestor being installed for the Cedar Rapids WPC Solids Project could accommodate up to 47,300 pounds of volatile solids per day. As CRLCSWA alone does not have sufficient food waste separated for management at this time, this Alternative assumes a feedstock blend would include the diverted food waste, high-strength waste, fats, oils, and greases (FOG); and dilution water until such a time that the organics tonnage could be increased.
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> *Alternative 2* was performed to review the benefits of installing a smaller digester that processes the food waste volume assumed to be available through diversion from CRLCSWA through a voluntary collection program.

Both analyses assumed that the digestors would process 20 tons per day (TPD) or 7,300 tons per year (TPY) of food waste. The key difference is the size of the digestor – thus, the amount of RNG produced and the volume of material paying a tipping fee for management.

Language Differences Between Solid Waste and Wastewater
Solid waste and wastewater treatment facilities use different metrics to discuss sizing and capacity. The solid waste industry measures inputs in tons, while wastewater treatment facilities measure inputs in volatile solids loading rate. The capacity of digesters is measured in volatile solids pounds per day (VS dry lbs/day). Food waste has a volatile solids content of approximately 85 percent volatile and a 50% dry matter solids content; therefore, the 7,300 tons/year of food waste added to the digester is equivalent to 40,000 lbs per day or 17,000 dry lbs VS/day.

Summary of Key Findings

First, AD has the potential to manage food waste successfully. The evaluation identified, in either Alternative, that food waste AD could successfully be managed at the WPCF. The joint development of the AD at the WPCF would result in reduced overall capital through shared infrastructure.

The evaluation of the two alternatives results in several key findings.

- Alternative 1: Full-scale digester with a feedstock of food waste, high-strength waste, and FOG, processing up to 47,300 dry pounds of volatile solids per day.
    - A receiving facility would de-package the food waste to prepare it for processing in the digester. The food waste would be blended with other feedstocks until more food waste tonnage can be diverted.
    - The digester size is 1.8 million gallons (MG).
    - The estimated food waste processed through the digester will be 7,300 TPY, or 3 percent of MSW disposed of at the CRLCSWA Site #2 landfill in fiscal year (FY) 2022.

  - The estimated capital cost of the full-scale food waste digester is $29.2M.
  - Estimated operations and maintenance (O&M) costs for the full-scale food waste digester onsite at WPC are $1.1M per year.
  - Revenue projections from tipping fees for the FOG and high-strength waste are $820,000 per year.
  - The food waste treatment cost per ton ranged from $92 to $228, depending on the revenues from RNG sales.
  - Depending on RNG revenues, the payback period for the WPC ranges from 17 years to 43 years. This payback period does not include cost factor-share with CRLCSWA or food waste tipping revenues received by CRLCSWA.
- Alternative 2 (Food Waste Only): Small digester with a feedstock of food waste only, processing up to 17,000 dry pounds of volatile solids per day.
  - The digester size is 0.72 MG.
  - The estimated food waste processed through the digester will be 7,300 TPY, or 3 percent of MSW disposed of at the CRLCSWA Site #2 landfill in fiscal year (FY) 2022.
  - The estimated capital cost of the small digester is $16.1M.
  - The estimated O&M costs are $477K per year.
  - There were no non-food waste tipping revenues from the small digestor.
  - The food waste treatment cost per ton ranged from $133 to $188, depending on the revenues from RNG sales.
  - The payback period would be at least fifty years due to low revenues. The facility would have a negative net revenue if RNG is at the lower end of the estimated potential ($10/MMBtu).

Forward 2044 Comparisons

The food waste diversion estimates developed for CRLCSWA's Forward 2044 project were based on general industry knowledge and focused on diverting as much of the organic waste stream from landfill disposal as possible. In contrast, the TM assumed that food waste would be collected through a voluntary diversion program developed over time. Other methods can be evaluated, such as mandatory diversion.

The voluntary diversion program estimated that food waste comprises 22 percent of the MSW stream, and 20 percent of that could be captured and brought to the digester facility.

The expenses and revenues presented in the TM are all assumed to be the City's responsibility, given the unknown nature of cost-sharing with CRLCSWA. Potential landfill tipping fee revenues were not included in the study.

Table 1 shows the costs for the construction and operation of AD in Alternatives 1 and 2. Please note the cost of collecting, separating, and processing organics is not included in these costs.

Table 1 – Comparison of Alternative 1 and 2

		Alternative 1		Alternative 2	
		Year 1		Year 1	
Food Waste Tonnage	Food Waste Tons Available for AD	37,900 TPY	Food Waste Only	37,900 TPY	Food Waste Only
	Currently Available Food Waste Tons Available for AD	7,600 TPY	-	7,600 TPY	-
	Total Organics to Digester	7,300 TPY	20 TPD	7,300 TPY	20 TPD
Other Feedstock, if needed	FOG & High Strength Waste to Digester, Industrial	47,500 gpd	Added until Food Waste tonnage meets full capacity	Not Needed	-
Opinion of Costs	AD Capital Cost	$29.2M	Includes $7.7M for Dewatering Facility & AGS Expansion; $2.5M Biogas Treatment	$16.1M	Includes $2.3M for AGS Expansion; $1.0M Biogas Treatment
	Amortized Capital Cost	$2.4M/yr	20 years @ 5%	$1.3M/yr	20 years @ 5%
	O&M Costs	$1.1M/yr	-	$477,400/yr	-
	RNG Revenues	$1.5M/yr	To City at $15/MMBTU	$597,000/yr	To City at $15/MMBtu
	Tipping Fee Revenues – Food Waste	$0	Not Included	$0	Not Included
	Tipping Fee Revenues – Other	$820,000/yr	FOG, High Strength Waste, Industrial, Regional Partners	$0	None
Net Total Food Waste Treatment Cost, $/Ton (before Tipping Fee Revenues)		$185/Ton	Average @ RNG $15/MMBTU	$160/Ton	Average @ RNG $15/MMBTU

Forward 2044 Recommendations

The following are items for CRLCSWA to consider next in the Forward 2044 process regarding the potential food waste digester project with City's WPC Facility.

- **Finding** - AD is a management tool that can successfully manage food waste.
- **Recommendations** - This study evaluated co-digestion using the WPC Facility but did not explore other organics treatment technologies to understand costs better.

  Near-Term – HDR believes that if either Alternative 1 or 2 were installed, it would not create a significant diversion in the tonnage going to Site 2. Thus, not creating a significant increase in the life of Site 2. HDR does not recommend proceeding with this option to meet Near-Term needs.

  Forward 2044 – HDR believes that AD is a successful management method for food waste, and the economic viability may be more reasonable on waste management beyond 2044. HDR recommends keeping this option for further consideration.

  Start cost-share discussions with the WPC and City leadership. Cost sharing does occur within the Forward 2044 solid waste campus scenarios. The estimated combined tip fee for each scenario internalizes the cost-sharing between the solid waste facilities (i.e., the operations and management costs of landfilled tons are less than the tip fee, while the anaerobic digester facility costs per managed ton are greater than the current tip fee).

  Voluntary Food Waste Programs. Additional information should be developed on the voluntary food waste programs that could be created. Although the proposed food waste digester project would only divert about 3% of MSW from the landfill, developing a food waste collection and diversion program could lead to other projects, such as a regional active aeration compost facility.

  The Agency should explore other treatment methods, such as composting or dedicated anaerobic digestion (such as high solids wet or plug flow digestion or dry or stacked digestion), and compare the results of those options to these results before determining the preferred path forward.

References:

1. HDR, 2022. *Technical Memorandum Food Waste Digester Feasibility*. WPCF Solids Phase 1. Cedar Rapids, IA.
2. HDR, 2021/2022. *Long-Term Waste Management System Evaluation (Forward 2044) Final Report*. Cedar Rapids Linn County Solid Waste Agency (CRLCSWA).